AI Deep Learning and Data Security in the Internet of Everything

RODRIGUES, Marcos <http://orcid.org/0000-0002-6083-1303>

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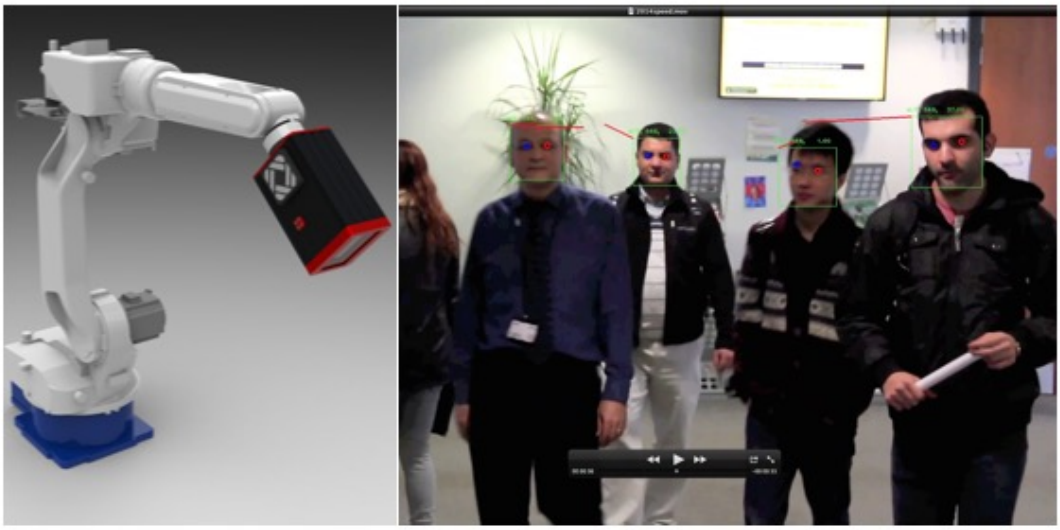
AI Deep Learning and Data Security in the Internet of Everything

Professor Marcos Aurelio Rodrigues



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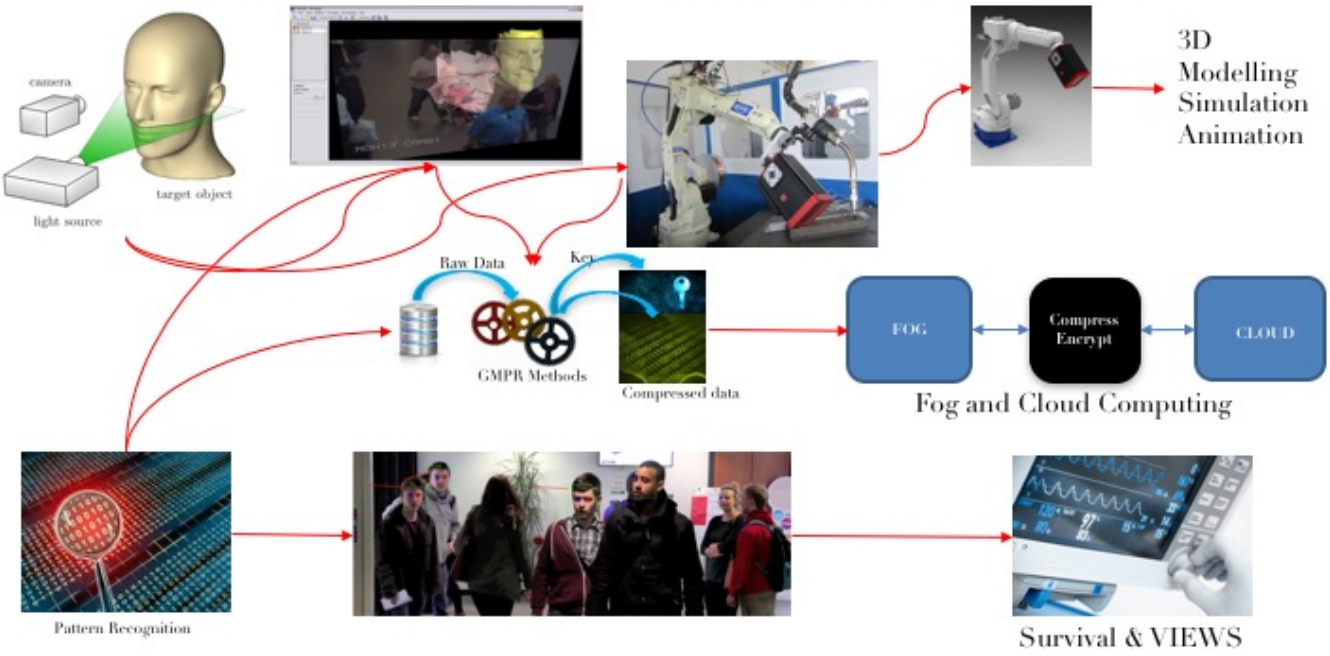
From 3D Reconstruction to Medical to Security

Underlying technology is pattern recognition



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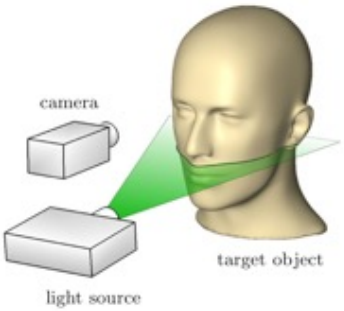
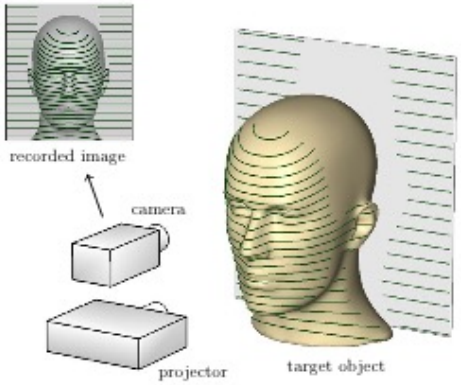
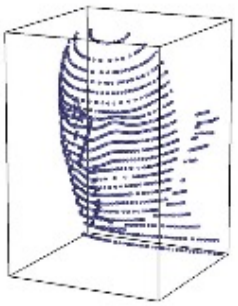
The GMPR 3D scanning technologies
3D with single image







Each light plane is uniquely detected by original algorithms

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MARWIN Project: full design integrated into a robotic arm
The actual robotic cell

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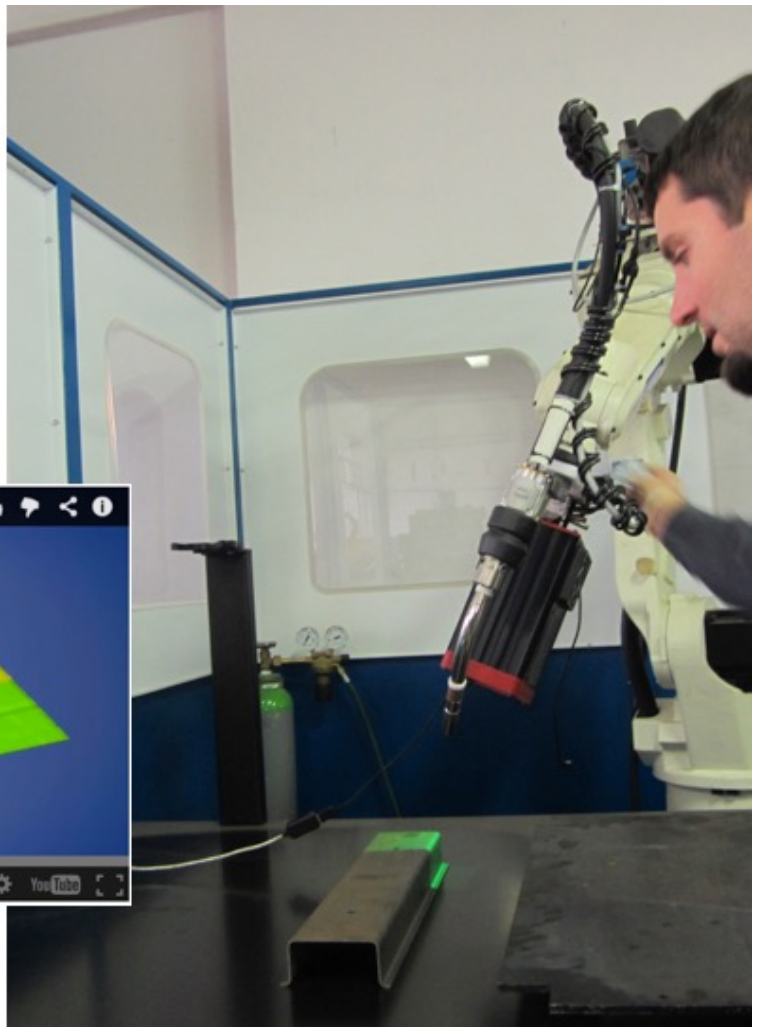
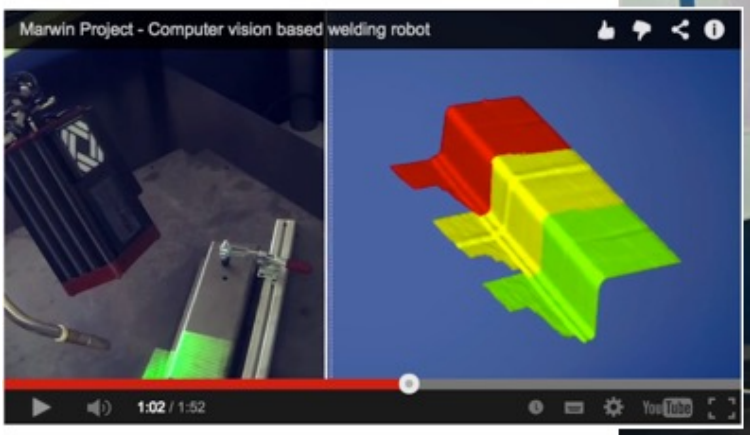


Scanning a part



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The ADMOS Project

Gender classification and age estimation

Ateknea Solutions Hungary

RUBIN Informatikai Zrt.

FLEXIBLE OPTICAL

impactmedia

X-TREME

CERC

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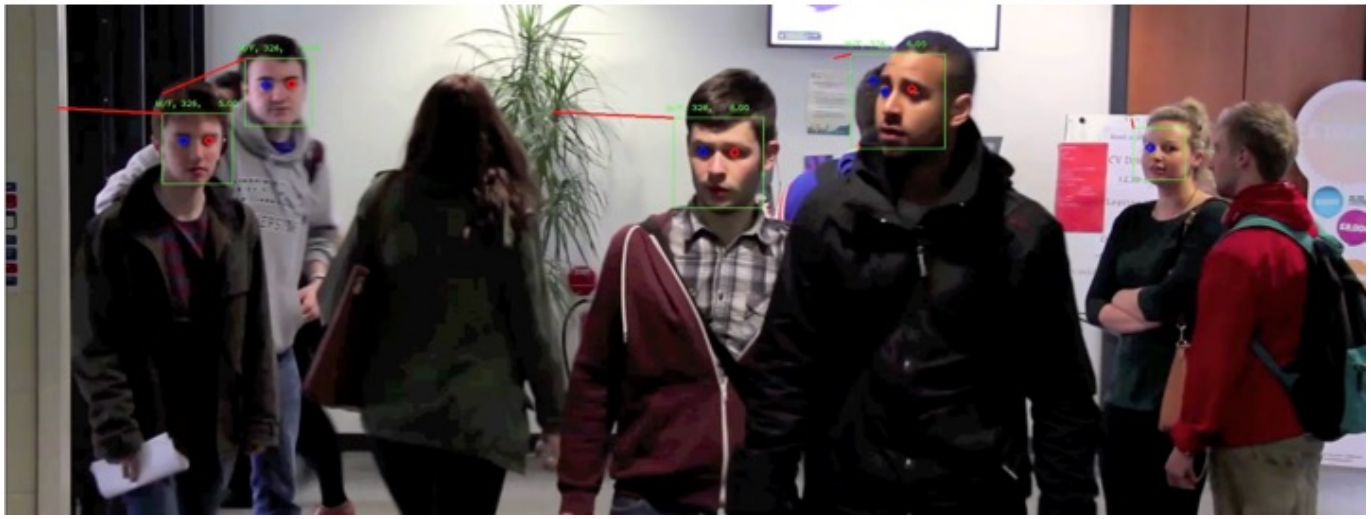

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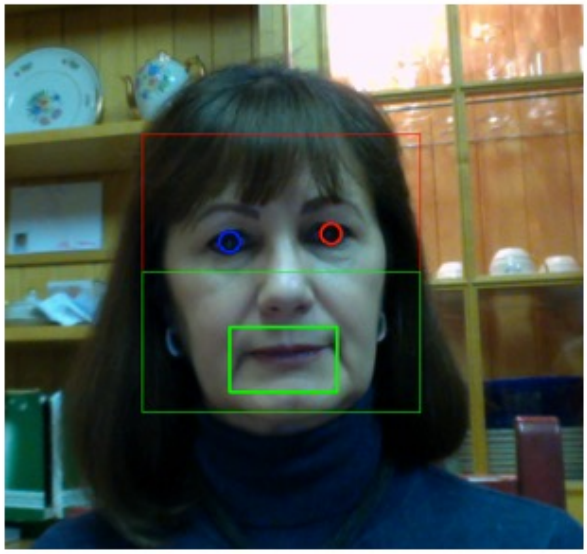
Client Side Software Development
Firmware and control s/w development

Real time processing:

1. face detection and tracking
2. eye tracking
3. other feature tracking (mouth, nose)
4. cropping the various face-ROI
5. gender classification
6. age estimation
7. save statistical info to an xml file
8. transmit to server at periodic intervals



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Applying binary patterns to face images
Visualizing the differences on images

Input image

LBP 3×3

Census 3×3

Modified Census 3×3

Census 5×5

Modified Census 5×5

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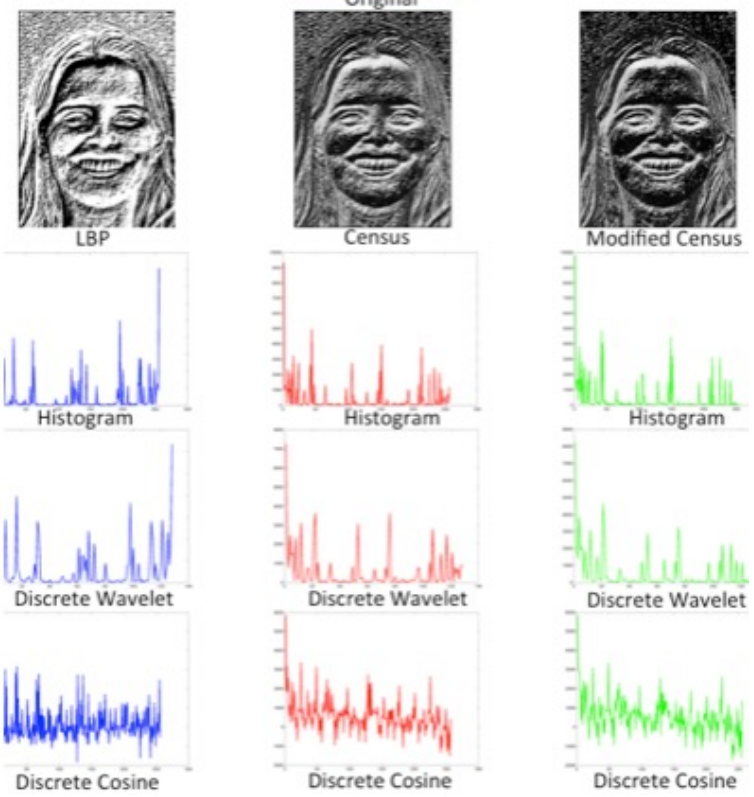
Comparative analysis of binary patterns

Raw histograms

Transformed histograms by DCT

Transformed histograms by DWT



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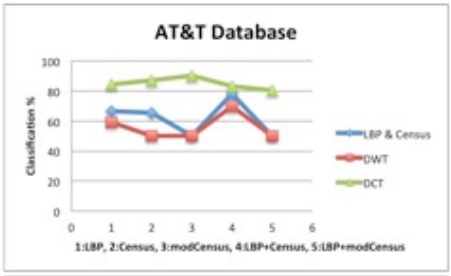
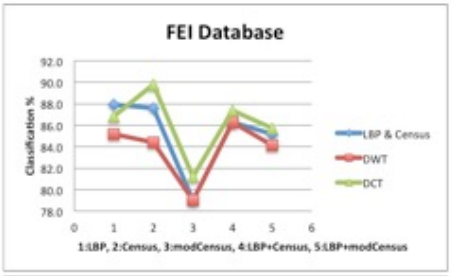
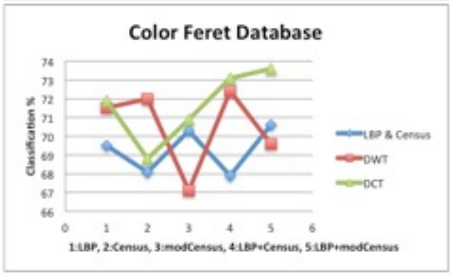
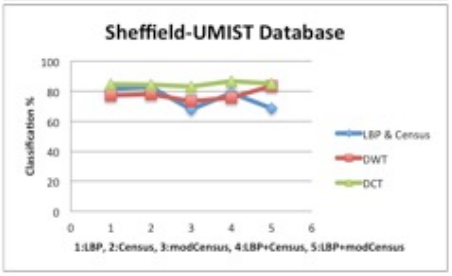
Classification results

Four public databases









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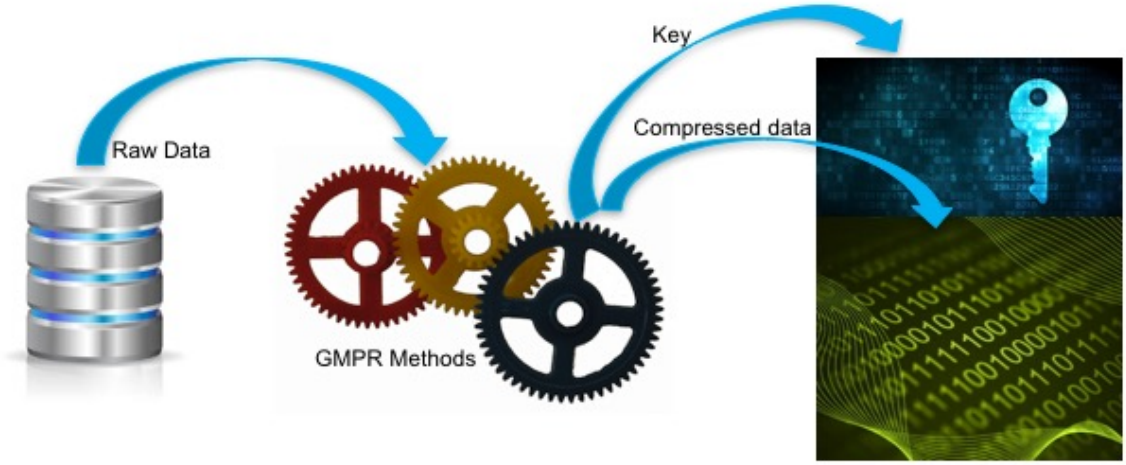
GMPR compression-encryption

Automatic generation of encryption key



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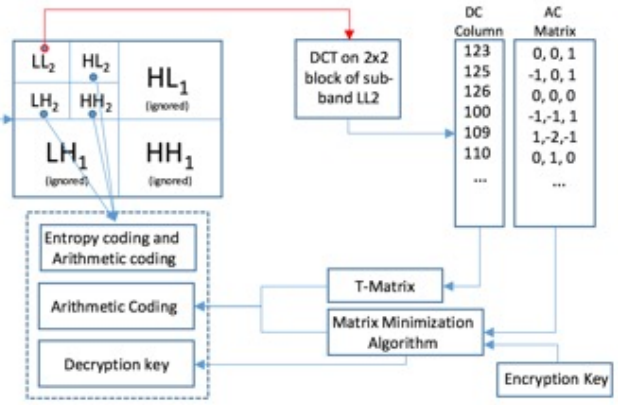
The GMPR method

Automatic generation of compression-encryption key



Main novel steps:

1. Data divided into blocks
2. Delta or differential process
3. Triplet encoding into a single value

Many transformations can be applied before or after, e.g.:

DCT, DST, DWT, DFT,
Quantization,
Entropy coding,
Arithmetic coding, etc.

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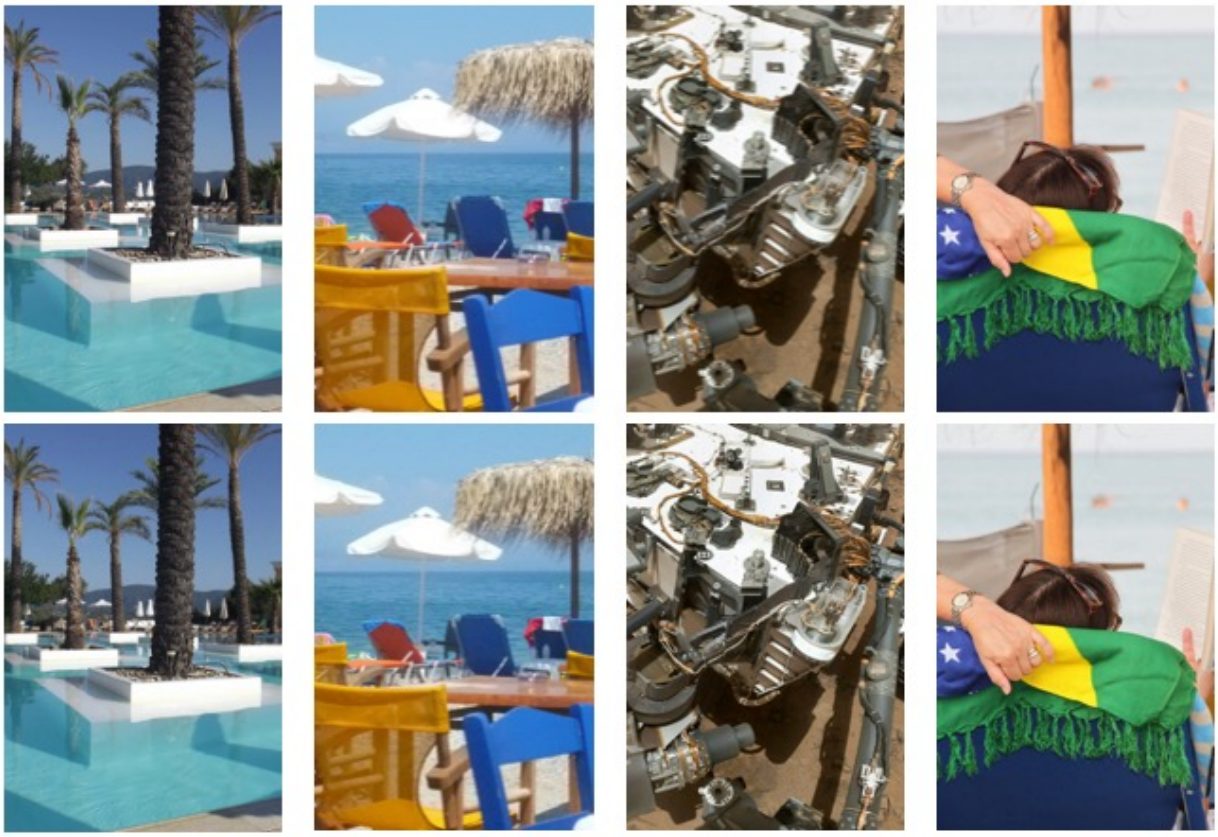
Experimental Results

2D Images: Original v. GMPR



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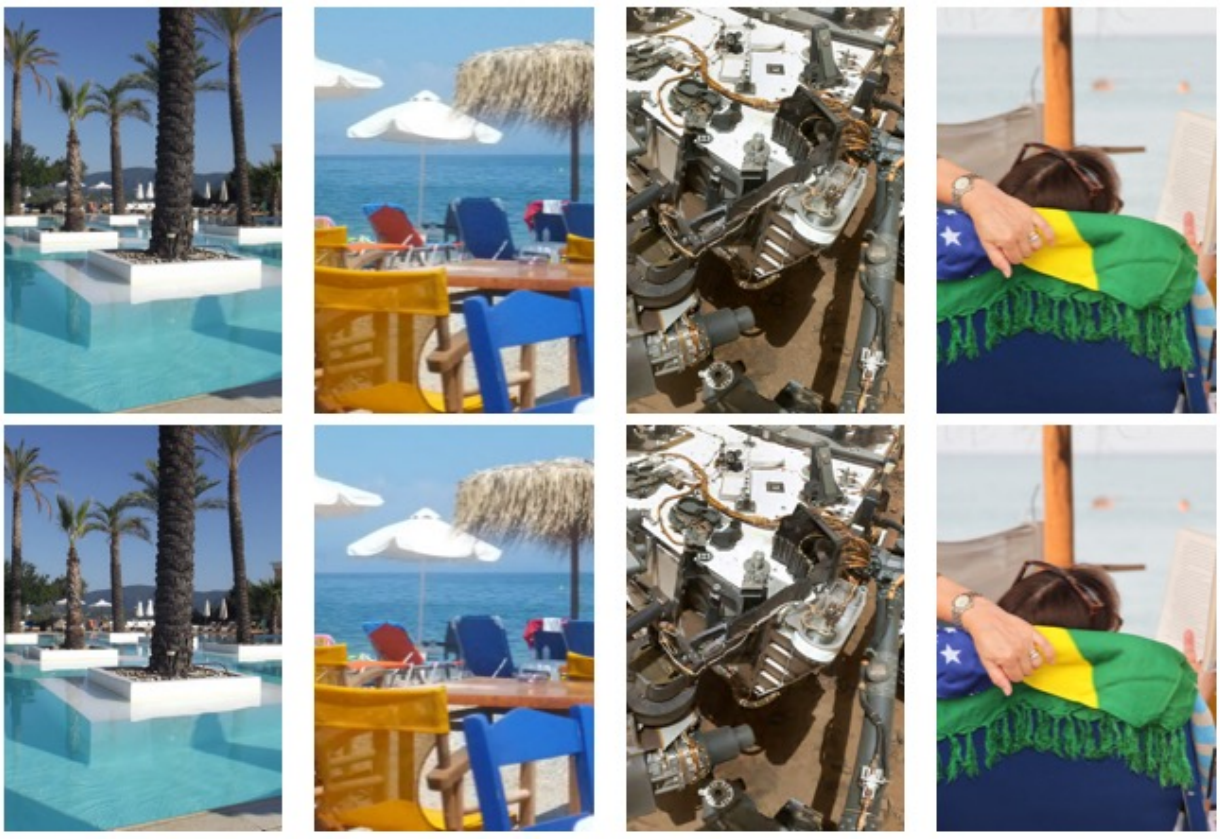
Experimental Results

2D Images: GMPR v. JPEG2000



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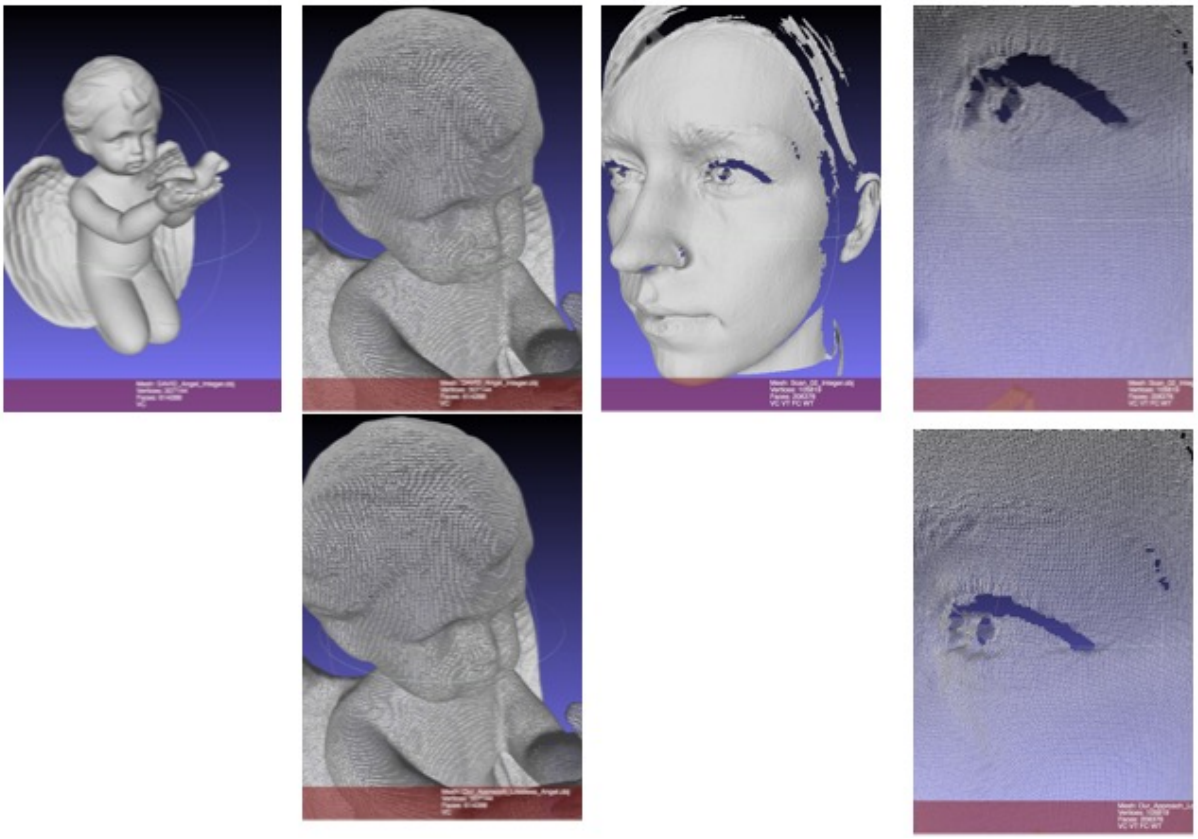
Experimental Results
3D lossless compression



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Comparison of Lossy and Lossless compression with popular Unix/Linux compression utilities

File	Original size (MB)	GMPR Method (MB)	Lempel-Ziv-Welch (MB)	xz (MB)	gzip (MB)	bzip2 (MB)
Angel (floating point)	24.7	2.670	7.3	3.1	5.5	5.3
Face (floating point)	14.0	0.290	4.7	1.2	3.3	2.6
Average compression ratio		94% (lossy)	69%	90%	78%	81%
Angel (integer)	19.1	3.35	6.3	2.7	4.6	4.8
Face (integer)	12.0	0.556	4.1	0.723	2.7	2.1
Average compression ratio		89% (lossless)	66%	90%	77%	79%

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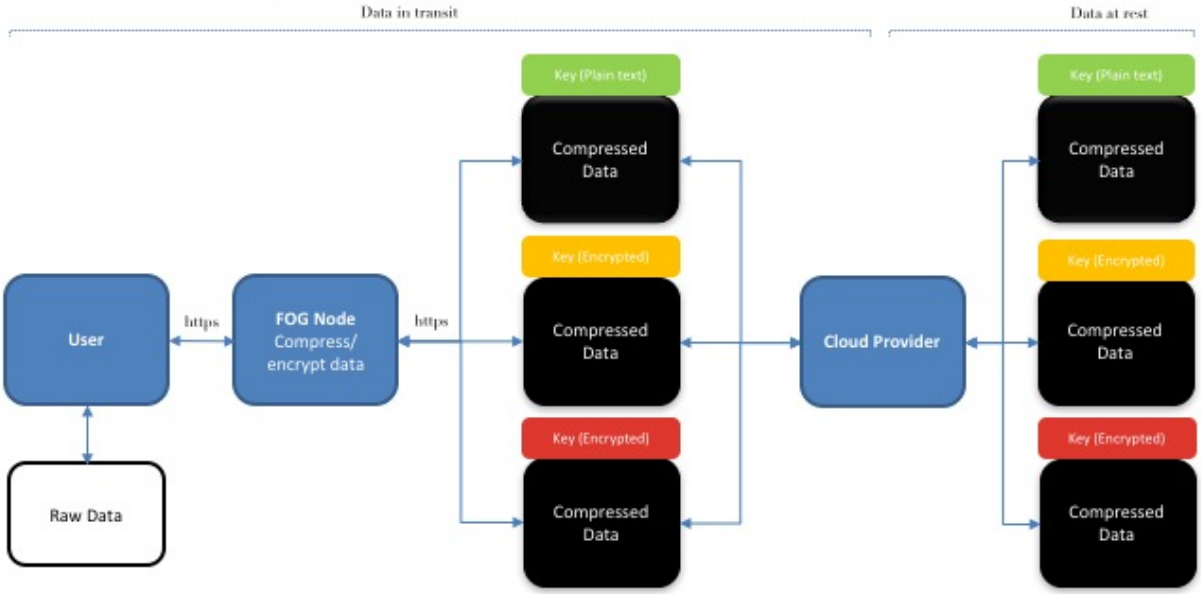
Vision for Fog and Cloud Computing
Only compressed data are kept in the Cloud



All data processing and enforcement of company's security policy are performed in the Fog

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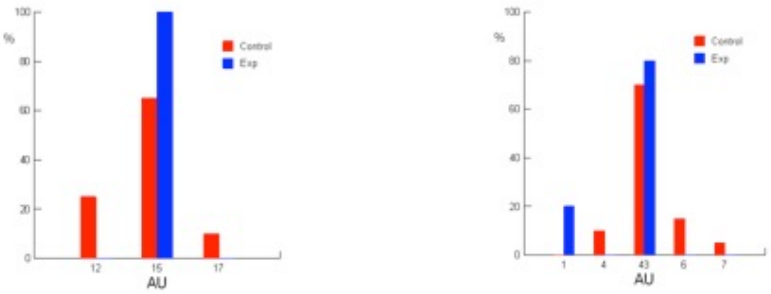
A novel method for identification of patients at risk of deterioration using FACS



The research has demonstrated for the first time that patients at risk of deterioration and terminally-ill have similar patterns of AU in the lower and upper parts of the face, with peak frequencies of AU 15 and 43 respectively

Jeronimo Moreno-Cuesta, Maria Madrigal, Alex Shenfield, Marcos A Rodrigues (2016). A novel method for identification of patients at risk of deterioration using FACS. *Journal of the Intensive Care Society*, in press.

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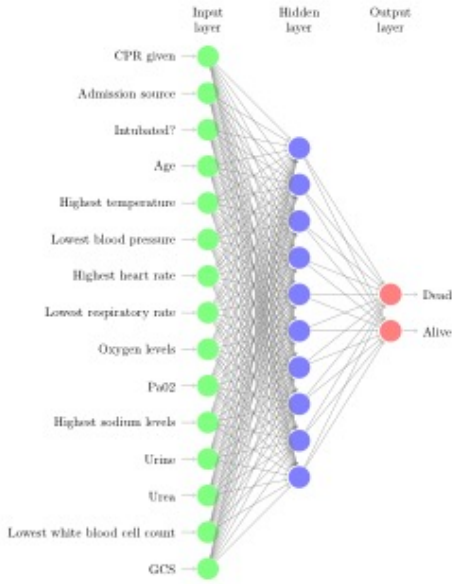
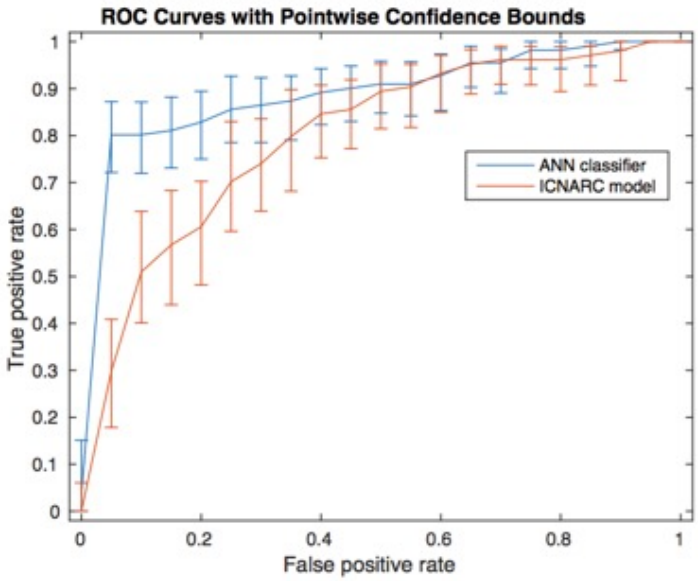
An improved classifier for mortality prediction in adult critical care admissions





SHENFIELD, Alex, RODRIGUES, Marcos, VALENTINE, D, LIU, D and MORENO-CUESTA, Jeronimo (2015). An improved classifier for mortality prediction in adult critical care admissions. *Journal of the Intensive Care Society*, **16** (4), 118.

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Future Directions
GMPR main priority areas

Medical engineering:
- Deep Learning: survival prediction with 100s thousands patient data
- VIEWS: computer vision FACS analysis to detect patients at risk of deterioration in critical care

3D Reconstruction:
- Collection of 3D facial data from up to 5,000 subjects

AI and pattern recognition:
- Deep Learning: intrusion detection from network packet data
- Deep Learning: 2D and 3D face recognition

Security:
- Tracking of financial transactions
- Intrusion detection
- Data compression and cloud security